GLENN LOVELACE, *Founder and CEO of TManage, Inc., Austin, Texas*

The Nuts and Bolts of Telework

Growth in Telework

More than 19.6 million people reported working as telecommuters in 1999.[1] Gartner Group predicts that more than 137 million workers worldwide will be involved in some form of remote work by 2003.[2]

Sage Research found that 70% of all U.S. organizations with over 5,000 employees currently have or plan to have telecommuters.[3] While telecommuting programs are far more common in large organizations, a new wave of telecommuting deployment is expected from small and medium organizations in the near future. 40 three percent of all organizations with less than 1,000 employees have plans to initiate a telecommuting program.

Technology Making Telework Possible

Through the years, home office technology has become increasingly sophisticated, to the point that now many home offices are truly extensions of their corporate counterparts. The current state of telework allows the telecommuter all of the flexibility of telework without having to sacrifice the technical support available in the corporate environment. During the past 5 years, the cost reduction of home office equipment and services, combined with increased bandwidth and Internet-based functionality, have enabled even those who work from home less than one week per month to be wellequipped with a variety of advanced technology products and services. [4]

From 1998 to 2000 the use of PCs in the offices of teleworkers rose from 67% to 80%, with the figure expected to reach at least 90% by 2003.[5] Approximately 35% of formal telecommuters have multiple PCs in their home offices and 40% of them have a local area network in place.[6] Many teleworkers remain connected to the home office and conduct vital research via the Internet, with approximately 85% of all teleworkers possessing Internet access.[7] Other technology is spurring the advance of telecommuting, as well. Formal telecommuters own an expanse of supporting technology, including fax machines (50%), copiers (45%) and personal digital assistants (16%). Supporting anytime/anywhere availability, approximately two-thirds of all teleworkers also have cellular phones.[8]

Growth of Broadband

After a series of fits and starts, the broadband industry appears on the brink of a significant advance. Industry leaders, such as SBC, Verizion, Covad and Excite@Home have all indicated their intention to

accelerate spending on broadband services in an effort to satisfy demand that has proven stronger than first anticipated.[9]

Since the majority of PCs today are sold with a pre-installed analog modem, most users are able to receive Internet access at no incremental equipment cost. This makes the $200 average cost of buying and installing DSL or cable modem equipment prohibitively high for many mainstream Internet users.[10]

Although the current barrier to entry for broadband customers is high, this issue will not deter the expansion of broadband indefinitely. Currently, DSL and cable modem equipment suppliers are working toward industrywide standards that should greatly reduce the cost of equipment and that will eliminate the need for professional home installation.[11]

The Benefits of Telework

Telework's Employee Benefits

Flexibility in work schedule: Rather than being bound to a traditional 9 to 5 schedule, the teleworker can work when they are most productive, be it 9 to 5 or 5 to 9.

Decreased lost time commuting: Employee commute time is reduced or eliminated. In one AT&T unit, the average teleworker gained almost 5 weeks per year by eliminating a 50minute daily commute.[12]

Increase in quality of life: The nation's communities can benefit from telecommuting, which gives workers more time to spend at home with their families.[13] 75% of AT&T's employees who telework one or more times a week say their personal and family lives are improved.[14] Fully 100% of Nortel employees who telework reported reduced stress and increased satisfaction.[15]

Telework's Employer Benefits

Attraction of employees, specifically high tech workers: Offering their employees the ability to telework gives companies an important competitive advantage in attracting employees. Telework was rated the number one benefit for high tech workers in a study conducted by the Information Technology Association of America.[16]

Telework has been found to increase employee retention. For companies that implement formal telework programs, telework reduced employee turnover by an average of 20%.[17] A 1997 AT&T survey of telecommuters showed that 36% of employees would quit or find another work-at-home job if their employer decided they could no longer work at home.[18]

Telework has also been found to increase worker productivity. Teleworkers work longer hours and more workdays than the average desk-bound employee.[19] In an AT&T sponsored survey of Fortune 1000 managers, 58% reported increased worker productivity. American Express experienced a 20% gain in

productivity when the company moved its on-site people to off-site call centers. Nortel experienced a 26% productivity increase in its teleworkers.[20] U.S. West found that telecommuting employees showed a 50% improvement in productivity during a 1997 trial.[21] At IBM, a survey of employees in the Mobility Initiative revealed that 87% believed that their personal productivity and effectiveness on the job had increased significantly.[22]

Telework has resulted in the reduction to facility costs. From 1991 to 1998, AT&T freed up some $550 million in cash flow — a 30% improvement — by eliminating offices people don't need, consolidating others, and reducing related overhead costs.[23] IBM saves $75 million per year by having 10,000 employees mobile,[24] and has documented 40 to 60% reductions in real estate costs.[25]

Telework can expand the radius as well as the depth of the labor pool. By offering telework, companies expand their labor pool to include geographically distant workers, as well as disabled workers and parents staying at home with children.

Telework's Environmental Benefits

Telework may affect a reduction in traffic congestion and air pollution. While the population grew 22% in the nation's largest urban areas over the past 15 years, traffic congestion grew by an astounding 235%.[26] In 1999, there were 32 ozone non-attainment areas across the country. Some of the country's largest cities, Los Angeles, Atlanta, New York, and Houston, to name a few, did not meet national air quality standards.[27] The National Environmental Policy Institute (NEPI) states "telecommuting presents a non-coercive way for corporations to help the nation achieve environmental goals and improve quality of life."[28]

The International Telework Association and Council conducted a study of teleworkers in 1999 that found that on non-telework days, 87% of teleworkers drive to work alone.[29] On average, each teleworker saved 33.2 commute miles per teleworking occasion. That is 28.5 pounds of pollution emissions saved in just one day by just one person.[30] If this employee teleworks 2 days a week, for 50 weeks, that is a reduction of 2850 pounds of pollution emissions per year by one teleworker.

The Benefits of Telework Outweigh the Costs

As an ever-expanding list of companies has discovered, the benefits of formal telework programs far outweigh the costs (see Case Studies below). Study after study shows that employee satisfaction, [31] retention[32] and productivity[33] are all 10-30% higher for teleworkers than for their non-teleworking counterparts. With formal telework programs, organizations gain happier, more productive employees while saving an estimated five to ten thousand dollars per year per teleworking employee.[34]

The coming expansions in bandwidth and improvements in technology, coupled with the anticipated reductions in cost, paint a telework future with greater benefits at lower costs**.**

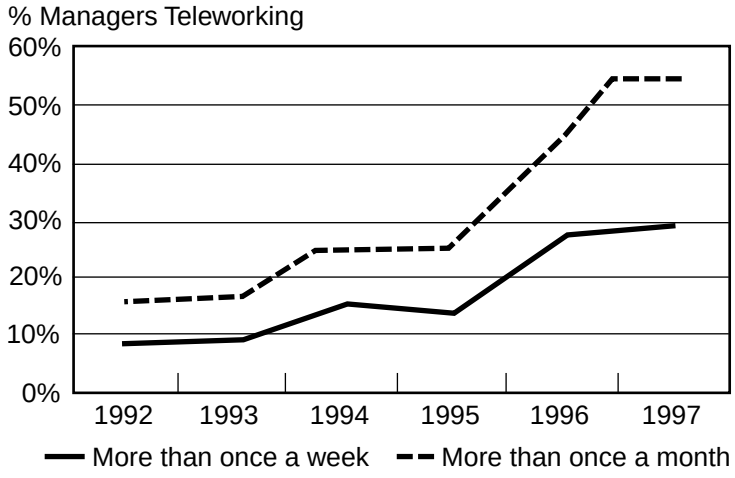
Case Studies in Telework

Some of the country's largest employers are already forging a path with formal telework programs. They realize that teleworking not only makes their employees happier, but it also lowers costs and improves their competitive advantage.

AT&T

In 1998, AT&T cut $C0_2$ emissions by 55,000 tons and saved 5.6 million gallons of gasoline. On the softer side, 71% of surveyed employees at AT&T reported feeling more satisfied with their jobs because of telecommuting. But what really made AT&T happy is that since 1991, the company has freed up $500 million in cash flow through telework . . . and reduced office space costs by 50%.[35]

Growth of Telework at AT&T[36]



Merrill Lynch

In 1996, Merrill Lynch launched a formal telework program with 2,400 of their 65,000 employees worldwide. Merrill Lynch saw a productivity increase of 10-50% and a 30% increase in employee morale.[37]

Nortel

Nortel implemented a formal telework program in 1994. In the first four years, the program grew to 35,000 teleworkers. Deployed in over 8 countries, the Nortel program saw employee satisfaction increases of 10.4%, productivity increases of 26%, and one-time real estate savings of $60 million.[38] Satisfaction among Nortel teleworkers was 10% higher than the Nortel average.[39] Eighty-eight percent of employees reported increases in productivity, compared to a Nortel average of 22%.[40] Sixty-five percent of their managers reported increases productivity, compared to a Nortel average of 10%.[41]

Siemens

Siemens telework program involves one-fourth of their Enterprise Network Division's 1,300 U.S. employees. The teleworkers involved report a 15% productivity increase and Siemens has saved 60 tons of air pollution annually. Siemens use of hoteling will produce savings of over $1 million in real estate costs over the next five years.[42]

Technology Innovations on the Horizon

The following are some of the technologies that are enhancing the strength of telework.

Higher Bandwidth Connections

As mentioned above, broadband connections will become more readily available over time, at a lower cost. The three least expensive types of broadband access today — digital subscriber line (DSL), cable modem and satellite — will continue to expand to meet the demands of home office and personal users.[43] With strong demand and heavy supplier investment, Morgan Stanley Dean Witter predicts that broadband penetration will grow rapidly, reaching 12% in 2001, 35% in 2004 and 68% in 2009.[44]

Voiceover Internet Protocol

Currently, voiceover Internet protocol (VoIP) is expected to advance to provide fluid telephone service via the Internet. Internet calls are expected to soon rival the quality of telephone landlines.[45] Another area in which VoIP is gaining ground is in controlled network environments, such as a local area network (LAN). In a small-office or corporate situation, an internal LAN can be managed more easily, providing a certain level of performance.[46]

One company, for example, now offers small-office systems that accept all standard incoming voice calls, converts them to digital packets and passes them through a LAN to guarantee high quality at a low cost. Such systems can save companies thousands of dollars by avoiding a phone company private branch exchange (PBX) and providing a variety of features such as call forwarding and conference calling for free.[47]

Further on the horizon are such VoIP services as:

- A follow-me number that will ring up to nine other numbers sequentially until the calling party reaches you.[48]
- VoIP service on handheld and mobile devices.[49]
- Live customer service representatives responding instantly to questions as you browse web sites.[50]
- Telephones that will allow VoIP without a PC.[51]

Unified Messaging

Considered by many to be the Holy Grail of Internet telephony, unified messaging brings together into a single queue of messages all of the various media types that a person needs to handle, and provides both the sender and the recipient freedom to choose the media type. With unified messaging, all of the voice traffic currently on telecommunications lines will be converted into packets of data so that the PC and Internet can provide everything from phone calls to faxes and emails. For example, email could be read to the recipient over the telephone or called up online.[52]

Multimedia

Online presentations and desktop teleconferencing will be enhanced with greater bandwidth and enhanced technology. Although true desktop teleconferencing may be further down the road, streaming video and other technologies will continue to open avenues for online video communications, especially in presentation venues.[53]

Wireless

Wireless access is becoming more prolific and less expensive, as exemplified by the introduction of wireless web browsing through the latest hand-held personal digital assistants (PDAs). The number of subscribers to wireless data services is expected to grow rapidly from 170 million worldwide in 2000 to more than 1.3 billion in 2004.[54] As a result, more than 1.5 billion cellular phone handsets, PDAs and Internet appliances are expected to be equipped with wireless capabilities by the end of 2004.[55] Messaging is expected to be the primary driver of the increase, with the number of wireless messages rising from 3 billion in December 1999 to 244 billion by December 2004.[56] Other features, such as mobile commerce applications, entertainment, real-time financial information and travel information and services is expected to take longer to reach the market.[57]

Satellite

Although only one digital broadcast satellite (DBS) service provider currently exists in the United States, competitive DBS service providers expect to "launch" a number of satellitebased Internet access Internet-to-TV alternatives. This may be good news for the more than 60% of the North American market that is currently unable to get either cable or DSL broadband service.[58] Satellites offer an interesting and potentially viable access alternative for those who cannot get other broadband service; however, it will probably not be the solution of choice for those who can. DBS service provider's start at a technological disadvantage compared with DSL or cable because it provides only one-way communication from the satellite with a slower telco return path.[59]

Virtual Private Networks

Virtual Private Networks (VPNs) are networks that function as if they are private, although they actually exist on public wires. VPN data is protected through encryption and other security mechanisms. A

VPN, simply put, allows remote access workers to work off-site as if they are connected to the organization's internal network. A robust demand is expected for VPN services in North America, growing by at least 34% annually through 2003.[60]

Conclusion

In conclusion, with the advances in technology that have occurred over the past few years and will continue well into the century, telework has become a business strategy that an increasing number of organizations are employing to reap a broad spectrum of benefits. The benefits of telework — such as competitive advantage in attracting and retaining employees, increasing employee productivity and satisfaction, reducing facility costs and expanding the pool of workers to include nonlocal and disabled employees — far outweigh the costs. This trend will only increase as companies like SBC, parent company of Southwestern Bell, Ameritech, Pacific Bell, Nevada Bell and others, invest in building faster and more extensive broadband networks. For example, SBC is currently spending $6 billion to make superfast, alwayson Internet access available to about 80 percent of its customers — an estimated 77 million Americans — by the end of 2002.[61]

As the United States deals with the issues of attracting high tech companies to strengthen the country's participation in the new global information economy, while maintaining or increasing the quality of life of our citizens, there is one solution which must be considered before all others: telework.

Endnotes

[1] ITAC, "Employers Save $10,000 Per Teleworker in Reduced Absenteeism and Retention Costs," October 27, 1999, http://www.teleconimute.org/.

[2] C. Anderson and S. Payne, "Key Trends and Drivers of Telecommuting," *Inside Gartner Group*, May 6, 1998.

[3] Opportunities in Telecommuting: A Quantitative Analysis of Drivers, Deterrents, and Deployment Patterns," Sage Research, Inc., January 2000, p. 6.

[4] Sandler, Merle and Boggs, Raymond, "Bulletin: Telecommuters and Technology Use," International Data Corporation, April 2000.

[5] *Ibid*.

[6] *Ibid.*

[7] *Ibid*.

[8] *Ibid*.

[9] *The Broadband Report: Reaping What You Sow: ROI in the Broadband Market*, Morgan Stanley Dean Witter Equity Research North America, May 1, 2000.

[10] *Ibid*.

[11] *Ibid*.

[12] Mahlon Apgar, IV, "The Alternative Workplace: Changing Where And How People Work," *Harvard Business Review,* May/June 1998.

[13] Small Business Telecommuting Act, HR 3500, November 18, 1999.

[14] AT&T Web site, http://www.att.com/ehs/report98/tech/tech_3.html.

[15] International Telework Association and Council, 1997.

[16] Information Technology Association of America, "*Bridging the Gap: Information Technology Skills for a New Millennium,*" http://www.itaa.org/workforce/studies/hw00execsumm.htm.

[17] *Telecommuting 99 — Where We Are*, 1999, http://www.pacbell.com/products/residential/workathome/telecomm.html.

[18] June Langoff, *The Telecommuter's Advisor*, 1999, p. 21.

[19] *Ibid,* p. 22.

[20] International Telework Association and Council, 1997.

[21] June Langhoff, *The Telecommuter's Advisor*, 1999, pp. 22-23.

[22] Mahlon Apgar, IV, "The Alternative Workplace: Changing Where and How People Work," *Harvard Business Review*," p. 122.

[23] *Ibid.*

[24] Jennifer Bresnahan, "Why Telework?," *CIO*, January 15, 1998, p. 28.

[25] *The 3 Why's of Telecommuting*, http://www.telsuccess.com/whyof.htm.

[26] *USA Today,* November 23, 1999, cover story.

[27] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, August 1999.

[28] The National Air Quality and Telecommuting Act (as part of HR 2084) Final Report, p.3.

[29] *Opportunities in Telecommuting: A Quantitative Analysis of Drivers, Deterrents, and Deployment Patterns*, Sage Research, Inc., January 2000, p. 9.

[30] Figure derived by using www.teletrips.com.

[31] Ann Graham, Peter T. Leach, and Michael Bell, "Even Bulls Can Telecommute — How Teleworking Works at Merrill Lynch," *Business Technology Journal*, Gartner Group, July 31, 1999.

[32] *Telecommuting '99 — Where We Are*, 1999, www.pacbell.com/products/residential/workathome/telecomm.html.

[33] Ann Graham, Peter T. Leach, and Michael Bell, "Even Bulls Can Telecommute — How Teleworking Works at Merrill Lynch," *Business Technology Journal*, Gartner Group, July 31, 1999.

[34] Carol Leonetti Dannhauser, "Who's in the Home Office?," *American Demographics*, June 1999.

[35] AT&T web site, http://www.att.com/ehs/report98/tech/tech_3.html.

[36] "Telework Supports the TBL," http://www.att.com/ehs/report98/tech/tech_3.html.

[37] Ann Graham, Peter T. Leach, and Michael Bell, "Even Bulls Can Telecommute — How Teleworking Works at Merrill Lynch," *Business Technology Journal*, Gartner Group, July 31, 1999.

[38] International Telework Association and Council, 1997.

[39] Telecommute America, October 21, 1997.

[40] *Ibid*.

[41] *Ibid*.

[42] "Siemens Launches 22 City Teleworking Seminar Series," *Business Wire*, March 8, 2000.

[43] Neil Randall, "Net Gains Via Broadband — Broadband Options Are Reaching New Levels of Affordability and Availability," *Computer Shopper*, November 1, 2000.

[44] *The Broadband Report: Reaping What You Sow: ROI in the Broadband Market*, Morgan Stanley Dean Witter Equity Research North America, May 1, 2000.

[45] John R. Quain, "Dialing Without Dollars: Making Cheap, or Even Free, Phone Calls Over the Internet is More Than a Fad; It Could Be The Next Big Thing," *Computer Shopper*, October 1, 2000.

[46] *Ibid.*

[47] *Ibid.*

[48] *Ibid.*

[49] *Ibid.*

[50] *Ibid.*

[51] *Ibid.*

[52] *Ibid.*

[53] "Web-Based Communication: One to One or One to a Thousand," GartnerGroup, May 5, 2000.

[54] David Legard, "Study: 1.3 Billion Wireless Data Users By 2004," *Network World*, September 18, 2000.

[55] *Ibid.*

[56] *Ibid.*

[57] *Ibid.*

[58] *Market Analysis — Satellite Internet Access: DBS Players Weigh In*, GartnerGroup, March 30, 2000.

[59] *Ibid.*

[60] Technology Analysis — VPNs: Value Beyond Access, GartnerGroup, December 13, 1999.

[61] SBC Web site: http://www.sbc.com/technology/data-Strategy/project_pronto/home.htm.

Comments by O. Diane Bowles, Ph.D., *Director, Video Technology Resource and Education Center (ViTREC), Clark Atlanta University*

Growth in Telework

The term "telework" is used to cover a variety of flexible and alternative work arrangements including telecommuting, neighborhood or satellite centers, mobile and home-based workers. The Midwest Institute for Telecommuting Education (MITE) reports on its website that in 1999, almost 20 million people in the United States telecommute, which is defined as working off-site for an outside employer at least one day per month or more. These statistics further indicate that over 80% of those people telecommute part-time (1-3 days per week). The figure is an 80% increase from 1997 and these figures do not include the 50+ million mobile workers in which travel is a major component of their jobs.[1]

Even more impressive are the statistics from the 2000 Telework America Research Survey, sponsored by AT&T, reporting that new teleworkers in the United States have increased by 2.8 million and the new findings implying a total of 23.6 million teleworkers nationwide. The survey indicates a pent-up demand to telework — which supports the projection in the study that estimates as many as 30 million teleworkers by the end of 2004.[2]

The above statistics support Lovelace's assertion in his paper that telework is growing in staggering proportions each year. This author believes that the major contributing factor is the concomitant surge in growth of the Information Technology (IT) industry. It goes without saying that, today, the Information Technology (IT) industry is in the midst of sweeping transformation. The signs of change are everywhere. Companies and organizations are pressured to find "highly specialized knowledge workers" in order to be competitive.

The U.S. Department of Commerce projects that by 2006, almost half of the U.S. workforce will be employed by industries that are either major producers or intensive users of information technology products and services. Innovation has increased demand for high paid, "core IT workers" (e.g., computer scientists, engineers), created new IT occupations, changed skill requirements for some non-IT occupations, and raised minimum skill requirements for many other jobs.[3] The pressures for finding and retaining such workers are numerous. Additionally, communications and information technologies have enabled these knowledge workers to do a lot more from anyplace, anywhere. They are putting a lot of emphasis on lifestyle issues such as the balance of work and family. Now employers feel compelled to compromise and alter company policies if they want the particular skill set that a prospective employee has. Telework is an answer for both the employer and employee. It becomes a win-win proposition.

On the surface, it appears from Lovelace that telework is growing and catching on in all sectors of the economy. This author's research findings do not support this contention. While we see growth of telework

This project was funded under a purchase order contract from the Office of the Assistant Secretary for Policy. Points of view or opinions stated in this document do not necessarily represent the official position or policy of the Department of Labor.

in companies, the government is slow in adopting this practice. Teleworking has not taken off in the federal government as it has in the private sector. The government's sluggishness to embrace telework as an alternative work arrangement is coming to the forefront with senior government officials.

Recently the U.S. Transportation Department held its first Annual Washington Area Conference on Telework and Telework America. Transportation Secretary Rodney Slater called for cabinet secretaries and agency heads to have 20% of their eligible employees in the area teleworking by 2005. This would mean an ambitious goal of 70,000 federal workers involved in teleworking. According to David Bibb of the General Services Administration, teleworking has been slow to catch on in the federal sector because it represents a dramatic cultural change. He believes that telework is not just nice to do, it is necessary because the federal government has downsized and aged. The only chance to compete for the best and brightest is for agencies to offer teleworking.[4]

Moreover, the literature reveals that the tide may be changing for telework. There are early signs that indicate the once touted work-at-home situations are losing favor with employers. In a recent *Wall Street Journal* article it was reported that telework is reaching a plateau. Once thought to be a popular perquisite, more companies are now expressing dissatisfaction because they believe that it causes resentment among office-bound colleagues and weakens corporate loyalty. Some also believe that teleworkers miss out on last minute office meetings. What is "eye opening" about this report is information that indicates the perk has also lost sizzle with highly structured programs such as AT&T.[5]

While HR and managers do not openly express their feelings because of giving the appearance of being aggressive and insensitive to family time, the truth of the matter is that many companies only permit the veterans to telecommute and others now put a ceiling of six months on the time that workers may stay at home to work. The author believes the jury is still out on the findings regarding the true growth of telework. We must adopt a wait-and-see attitude because right now there is conflicting information. On the one hand, we are hearing about record growths in telework. On the other hand, reports are surfacing stating that companies are now rethinking their position on the matter and pulling back on permitting employees to telework. Even though most forecasts of the growth of telework continue to be exceptional, the actual magnitude of this growth trend must be monitored in light of other reports.

Who Teleworks

It should be emphasized that many teleworkers do not fall into neat categories. Their schedules may vary — they could be mobile working, flying in and out of airports one week, then at home for a morning, then in the office for the rest of the day or visiting customers the next evening. It is important to remember that these employers have agreed upon a set of core hours they are available to managers, office colleagues and their customers. With today's wireless and broadband technologies, they stay in touch as if they were in the standard office setting.

Recent research findings show that teleworkers tend to be over 25 years of age, with the average home-only teleworker in his/her early 40s. They are categorized into three main types, based on location when

teleworking. These types are: 1) solely home-based (89%); 2) solely telework-center based (7%); and 3) home and telework-center based (4%).[6]

According to an *Information Week* research survey of 11,706 IT staffers and 10,754 managers, managers aged 36 to 45 have the greatest demands for job flexibility. They are followed closely by staffers in that same age category, while few professionals under 25 consider flexibility a priority. Moreover, the importance of a flexible work schedule increases in relation to earnings. Among IT staffers paid a median salary of $75,000 and managers paid a median salary of $105,000, 77% and 98%, respectively, say that work flexibility is important. But among staffers earning a median of $45,000 and managers a median of $65,000, 47% and 60%, respectively, cite flexibility. Findings from this survey research reveal that what is important to employees today — even more than job stability, what they are paid, vacation time, and benefits — is workplace flexibility.[7]

Gaps are also seen between telecommuting potential and opportunity among workers of different education and income levels. Workers with a higher level of education are most likely to report they can perform their job from someplace other than the workplace, with 46% of college graduates and 48% of workers with a post graduate degree holding positions they believe can be performed outside the office. In comparison, only 35% of people with a high school education think they could perform their job functions at a place other than work.[8]

Technology

Technologies Enabling Telework

The term "enabling technologies" aptly describes the technologies that make telework possible. In the simplest situation, the plain old telephone may be the only technology that allows a teleworker to spend a few days per month at home completing paperwork, but at the same time staying in touch with colleagues in the office. At the other end of the spectrum we might have an entrepreneurial home-based worker using telecommunications, satellites, and multiple computers to work for clients around the world. The criterion is that at least one type of information technology is utilized to make telework possible.

Lovelace does an excellent job in describing the plethora of telecommunications and information tools at the disposal of the teleworker. Some of the very basic technologies that could assist a teleworker are: telephone; answering machine/answering service/voice mail; call forwarding/call waiting/caller ID; conference calling; long distance service; cellular telephone; Personal Digital Assistant (PDA); copier; fax machine; computer; modem; printer; scanner; Internet service; software programs for scheduling, word processing, spreadsheets, and mailing list; Palmpilot organizer; and pager.

For the advanced teleworker, in addition to the above technologies, there are other technologies and tools such as: Digital Subscriber Service (DSL) for high bandwidth connectivity to the home; wireless; desktop videoconferencing; multimedia; and Voiceover Internet Protocol (VoIP). In the future, as cellular phones and palmtops become more PC like and as PCs becomes more networkable and able to interface with other smart devices, more tools will be available to the teleworker.

Assistive Technologies for the Disabled

Lovelace does not go into detail about technologies to assist the disabled. In surveying the literature, one thing that comes through quite clearly is that technological progress implies the enhancement of applicability of information technology. This reasoning does not follow. In fact, what happens is that system engineers generally overlook special needs adjustment technology for handicapped workers. Handicapped people, quite frankly, are often excluded in design processes. Therefore, handicapped end users are left with a critical shortage of technology products to assist with their disabilities.

A few of the new technologies that are now in place for people with serious disabilities include:

- "Eye Gaze" communication system that allows people to operate a computer with their eyes;
- "Magic Wand Keyboard" for people with limited or no hand movement; and
- "Switched Adapted Mouse (SAM) and Trackball" that allows clicking the mouse with other parts of the body.

All of these assistive technologies aid the handicapped members in our society to work using appliances designed by engineers to address their special needs.

Finally, in surveying the literature this author found that telework is a viable work option for persons with chronic and changing disabilities. These disabilities include multiple sclerosis, lupus, HIV/AIDS, complications of cancer, arthritis, stroke, heart or respiratory disease, chronic back injury, chronic pain, progressive visual or hearing loss, and mental health conditions. In addition to using telework as a way for compliance with Americans with Disabilities Act (ADA), many businesses want to keep employees with chronic disabilities on the job and have the following other incentives to do so:

- Retain valued employees
- Reduce employee turnover and recruitment costs
- Control the rising cost of disability benefits

Companies cited for using telework or telecommuting as a valuable tool for opening up the workplace to people with a wide range of disabilities and chronic medical conditions and for complying with ADA requirements are Northland Insurance Company and RESOURCE, Inc. Nonprofit agencies include the Minneapolis United Way and SERVICE 800.[9]

Emerging Technology Innovations

Lovelace expounds on the technology innovations on the horizon. This author agrees with the identification of technologies such as broadband, VoIP, Unified Messaging, Multimedia, Wireless, Satellite and Virtual Private Networks. These technologies and their integration in the workplace provide many new opportunities for business and government to expand their operations into uncharted territory because they will always be in touch with their employees.

In reviewing the literature, most researchers agree that right now there are three revolutions at the forefront of our information society. C. Michael Armstrong, Chairman and CEO of AT&T described these technological revolutions recently in a speech delivered to AARP in May 2000.

The Internet Revolution

Nothing is moving more quickly. While radio took 30 years to reach 50 million people, TV took 13 years to do the same, and it took the WWW about half that time to reach twice as many people. Every day the Web adds 4,400 new sites and 2 million new pages.

The Broadband Revolution

When people start talking about broadband technology, remember one word — speed. With one fiber cable, we can transmit every issue of the *New York Times* for the past 100 years in one second. And these cables carry voice, data, and images — all at the same time. Not all broadband connections are wired, which leads to the third revolution — wireless.

The Wireless Revolution

The United States already has almost twice as many wireless subscribers (85 million) as it has homes with personal computers (48.5 million). And the next generation of wireless phones will be small enough to fit in your shirt pocket, fast enough to pull full-motion video off the Internet, powerful enough to run for 40 days on a single charge, and smart enough to work almost anywhere in the world.[10]

With the widespread deployment of wireless and broadband and further applications development over the Internet, the way is paved for more telecommunications and computing devices for the mobile teleworker in particular. We will see the convergence of the following:

- Phones;
- The Web;
- MP3 players;
- New devices for getting on the Web such as PacketVideo which will stream full-screen video on your handheld or wireless phone;
- The Gateway Internet Manager appliance which hooks up to DSL connections for speeds up to 784 kbps;
- The marriage of mobile phones and PDA devices that will integrate cellular capabilities into PDAs or vice versus;
- JAVA-enabled cell phones which double as a pager and two-way walkie-talkie;
- NOKIA handled device that will serve as a cell phone, PDA and camera; and
- Microsoft's pocket PC.

With the above devices and tools in their arsenal and high bandwidth network support, teleworkers will be empowered to carry on their business at home, on the road, anywhere in the United States and across the world. The entire globe will belong to the teleworker over the next few years.

Technological Innovations Needed to Increase Telework Adoption Pace

Although there have been many advances in the IT and communications fields, the diffusion of high speed data networks is at an embryonic stage, failing to reach the masses of potential teleworkers across this country. As an example, Dr. Braden Allenby, Vice President, Environment, Health and Safety for AT&T reported in his October 1999 testimony before a House Committee hearing on Telework that in AT&T's most recent survey of its employees, they found that their telecommuting numbers had flattened. The reason given by employees was the difference between data speed at home versus the office, narrow band vs. broadband.[11] High-speed broadband delivered to the rural and suburban areas from whence most teleworkers commute is a very important technological innovation that will insure the potential of advancing the adoption of telework. As a matter of fact, Gil Gordon often quotes a term from a book on telecommuting, which says, "work is something you do, not some place you go."

These broadband connections will enable customers to access five new services: telephony; digital TV; high-Speed Internet access; interactive TV; and small business communications. The rapid deployment of broadband to the home and businesses, urban and rural areas, therefore will be a critical technology innovation needed to increase the pace of adoption of Telework. Convergence, integration, high bandwidth, wireless communications, Internet, standards, interoperability and VoIP are key words that will be frequently used as discussions arise on technologies needed to increase pace for adopting telework.

The Role Costs Play in Telework Adoption

The literature does not suggest that cost is a key factor in telework adoption. Cost is not a high priority when deciding to adopt telework as a program. The benefits outweigh the costs particularly when consideration is given to the many tangible and intangible benefits of teleworking. Management is more concerned about managing a remote worker, measuring productivity, adjusting to the cultural change, overcoming any negative perceptions within the organization, developing trust and maintaining loyalty among the non-teleworkers rather than the cost to implement the program. Remember that the simplest tool for a teleworker to be effective is a telephone although most do have a computer, modem and fax machine. The only decision based on cost is whether or not the company will provide these technology tools or whether the employee must have them in advance. Given the supply and demand for IT employees, most hiring agencies opt to provide these resources.

There are cost considerations for any organization creating a telework infrastructure. Most conduct a cost/benefit analysis to arrive at the bottom line where they do the following:

- Quantify costs and benefits;
- Include initial and operating costs;
- Include initial and operating benefits;
- Include tangible and intangible benefits; and
- Use return on investment, if possible.

In telework implementation, some organizations may start small with numbers of up to 25 people. Experts say implementation with so few workers is ill advised for a large organization because it is hard to measure the success or failure of such a program. Nonetheless, costs are less when small steps are taken rather than plunging in. Some tips to follow for assessing the costs and benefits are:

- Identify number of teleworking days/period;
- Document technology requirements, create profiles: high, medium or low;
- Develop cost/benefit analysis with HR, IT, Facilities, Finance & Business Units;
- Combine hardware purchases with other actions, i.e., regular upgrades, mobile computing; and
- Drive toward continuous improvement.[12]

There are basic questions organizational management should ask before engaging in the above exercises such as:

- What is my organization trying to accomplish by implementing a telework program?
- Will telework increase productivity?
- Are we trying to allow employees more flexibility?
- What is it specifically that we want to do with the technology that enables telework?
- Will it be useful in answering existing needs?
- Is telework supportable within the existing IT infrastructure?
- Will it accommodate people with special needs?
- Will we have network security and privacy?

Too often we look at the technology and the Internet and think that it can address all our organizational needs. The reality is that the applications should come first. A technology infrastructure should then be built to support those applications in a way that is cost effective and brings about measurable improvements. Adhering to guiding principles and planning procedures when implementing a telework program will lead to making better decisions regarding the costs for adopting telework.

Benefits of Telework Outweigh the Costs

Lovelace succinctly cited the many benefits of telework in terms of benefits to the employer, benefits to the employee and benefits for the environment. In reviewing the literature, this author would add other areas of interest for employers seeking to embrace the notion of telework. They are adherence to governmental legislation such as the Clean Air Act as amended in 1990 to reduce pollution, the Family Leave Act of 1990, and the Americans with Disabilities Act.

It should be mentioned here that recent research suggests that business and government are awakening to the potential of telework in cases of disasters such as the California earthquake of 1994 which knocked out the bridge. Business finds that telework is a crisis management tool and uses it to continue business as usual when unions threaten strikes and boycotts. Virtual offices can be set up instantaneously utilizing basic technology such as a laptop computer, cell phone, PDA (personal digital assistant) and fax machine.

Where Lovelace is optimistic about the benefits of telework, this author wants to be more realistic about some of the intangible side effects that cannot be measured in dollars but are concerns nonetheless. For the teleworker, there are sometimes efforts on the part of employers to convert the teleworker into a contract worker. This type of worker then lacks job protection and benefits and may be pressured to work longer hours. Another issue not fully discussed is the perception on the part of teleworkers that they will be passed over for job promotions if they miss out on the office happenings for too long.

For the employer, there is the issue of getting the teleworker to maintain a clear distinction between work and home life. Legal concerns being discussed that affect employers' decisions to telework include selection discrimination, IRS rules regarding home office tax deductions, local land use (zoning) regulations, and workers' compensation. While manageable, these legal issues represent uncharted territory for company legal offices and impact the bottom line costs.

Areas for Further Study

Security, Privacy and Authentication

A new level of concern for network security was raised recently when Microsoft and Lucent Technologies became targets for computer hackers. A major concern of companies and organizations that endorse teleworking is that of security. It is relatively easy to build a strong firewall within an organization as the first line of defense when trying to secure information. However, when teleworkers access the databases from remote locations there is the possibility that even if they make "harmless" mistakes such as leaving a password around, these oversights lead to a security breakdown.

Virtual Private Networks (VPNs) are one solution as mentioned by Lovelace. However, the efficacy of VPNs as well as other technologies that provide encryption devices, smart cards, dynamic passwords, and

digital certificates for companies as ways to authenticate remote workers accessing the main database is an area that must be given further study. Security is an area where company costs increase when implementing telework programs because the teleworkers are exposing their companies to a shared information environment.

Tax Credits As Incentives to Boost Telework Adoption

Last fall both congressional houses voted to study ways to encourage companies to start telework programs to relieve traffic congestion and the air pollution it causes. AT& T representatives stated that there is a soon-to-be-released report on using telework to reduce air pollution. The report examines models for encouraging telework in five U.S. cities plagued by this problem. The model would allow companies to earn credits for cutting nitrous oxide (N_2O) and volatile organic compounds (VOCs) based on the number of employees who telecommute.[13]

Advanced Technology, Telework and Urban/Rural Disenfranchised Populations

There is a widening imbalance between wealth and opportunity, between the wired and unwired citizens of our great country. This picture is disturbing because African-Americans, Hispanics and other minorities will make up a large part of the workforce over the next 20 years. Moreover, a Gartner Group, Inc. study found only 35% of "lower-socioeconomic-status" Americans had access to the Internet, compared with 53% in the lower-middle bracket, 79% in the upper-middle bracket and 83% in the top bracket.[14] This information underscores the need to study how we prepare all classes of workers to become teleworkers.

Many in the workplace today who are teleworkers are also "highly skilled knowledge workers." To acquire these "knowledge workers," IT companies have lobbied Congress to pass legislation that calls for the significant increase in the number of H-1B visas issued allowing foreign workers to satisfy business requirements in this country. It is the author's opinion that we must grow our own. We need to understand that redressing this shortage of workers may require allocating major training resources, but the willingness to tackle the long-term underlying causes may prove to be more beneficial than offering short-term solutions. The nation's Historically Black Colleges and Universities are positioned nicely to serve as the catalysts for addressing this problem and prevent further social bifurcation in this society. This is an area that should be studied in terms of how telework can be a positive solution.

Conclusion

Gil Gordon, in a presentation made September 1999 at the Fourth International Telework Workshop in Tokyo, Japan, made the point that one of the three most serious mistakes we have made with telework is placing too much emphasis on the role of technology. He expounds on this notion by explaining that the fundamental idea behind telework is to decentralize the office.

Lovelace cogently expresses the idea that *telework moves the work to the worker rather than moving the worker to the work*. Due to the proliferation of all these new technologies, companies have the flexibility to use telework selectively and appropriately to decentralize their offices. Gordon says this means there will be some people who are teleworking and there will be others who will work at the office. In other words, the technology is the tool that helps telework, but it is not the main reason why we have telework today.[15] And the world will adapt to telework – not the reverse.

Information and communications technologies have taken a dominant place in our society, paving the way for the future growth of telework. Jack Niles, who coined the terms teleworking and telecommuting in 1973, predicts that telework will steadily increase as a work mode over the next few decades. He sees a future where telework may possibly become invisible; it won't even be distinguished from more traditional forms of work. We will be freed of the "edifice complex," a term Niles coined which basically means the need to have an impressive office building in order to demonstrate our worth and privilege.[16]

In summary, this author agrees with most of what was written by Lovelace on the nuts and bolts of telework. The principal contribution of this paper has been to place a broader emphasis on aspects of the telework phenomenon not covered by Lovelace.

As a final note, we are cognizant that telework is changing the fabric of our society . . . the way we work, the relationship between managers and employers, interaction among employees and the structure of cities. The eventual success of telework programs in the future must, however, account for the masses of people left behind. To address the needs of the IT workers to the exclusion of the disenfranchised and rural workers will be a calamity. All must be included in the new economy; it is not a luxury but a must.

Endnotes

Midwest Institute for Telecommuting Education (MITE), "FAQ: Telecommuting General Questions and Answers," wysiwyg://21/http://www.mite.org/FAQ/faqgenl/faqgenl.html.

[2] "New U.S. Teleworkers Grow by Nearly Three Million," *Excite News*, October 24, 2000, On-line.

[3] "The Emerging Digital Economy II: Executive Summary," U.S. Department of Commerce, http://www.ecommerce.gov/ede/summary.html.

[4] Colleen O'Hara, "Federal Government Raises the Bar on Telework," *Federal Computer Week*, October 25, 2000, wysiwyg://289/http://www.fcw.com/f…es/2000/1023/web-tele-10-25-00.asp.

[5] Dunham, Kemba, "Telecommuters' Lament," *The Wall Street Journal,* October 31, 2000, p. B20.

[6] "New U.S. Teleworkers Grow by Nearly Three Million," *Excite News*, October 24, 2000, On-line.

[7] Gene J. Koprowski, "Flexibility in the Workplace is an Increasing Concern," *Information Week*, October 16, 2000, p. 214.

[8] John J. Heldrich Center for Workforce Development at Rutgers, The State University of New Jersey, *Nothing But Net: American Workers and the Information Economy,* Heldrich Work Trends Survey, v.2.1: Winter 2000, p. 11.

[9] Midwest Institute for Telecommuting Education (MITE), "Telecommuting: *A Work Option for Persons with Disabilities*," http://www.mite.org/telecommutdisabilities/telecommutdisabilities.html.

[10] C. Michael Armstrong, Chairman and CEO of AT&T, "Integrating Futures," Speech delivered to American Association of Retired Persons, Orlando, FL, May 18, 2000.

[11] Dr. Braden Allenby, Vice President for Environment, Health and Safety at AT& T, Testimony given during House Committee Hearing on Telework, Washington, D.C., October, 1999.

[12] Nancy Anderson, "*Telecommuting/Teleworking: Making the Business/Management Case,*" April 1999, http://www.ot.state.mn.us/ot_files/content/govsvcs/powerpoint/sld010.htm.

[13] AT&T's *Telework Webguide,* http://www.att.com/telework/artlib/taxcred.html.

[14] Study: "Millions May Lag As Internet Grows In U.S.," October 2, 2000, http://www.cnn.com/2000/TECH/computing/10/02/internet.usa.reut/index.html.

[15] Gil E. Gordon, "What Will Telework Change and What Kind of Future Will it Bring? Today and Tomorrow in the Leading Telework Country," Presentation given at Fourth International Telework Workshop, Tokyo, Japan, September 3, 1999.

[16] Jack Niles, *Managing Telework: Strategies for Maximizing the Virtual Workforce,* John Wiley and Sons, Inc., New York, 1998, pp. 295-296.